CEI UPM | Centro de Electrónica Industrial

WORK IN PROGRESS:
Adaptive-Reactive Cooperative System for Object Identification

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POLITÉCNICA "Ingeniamos el futuro"

CAMPUS DE EXCELENCIA INTERNACIONAL

Outline

Introduction

- **Identification System**
- **Cooperative System**

Cooperative Model

- **Selection Algorithm: Previous Solutions**
- **New Proposals:**
  - *Particle Filter-based Approach*
  - *Contributions-based Approach*

Identification System

- Radar device for identifying.

- ~~Radar location~~
- **Object trajectory**
- ~~Training set~~

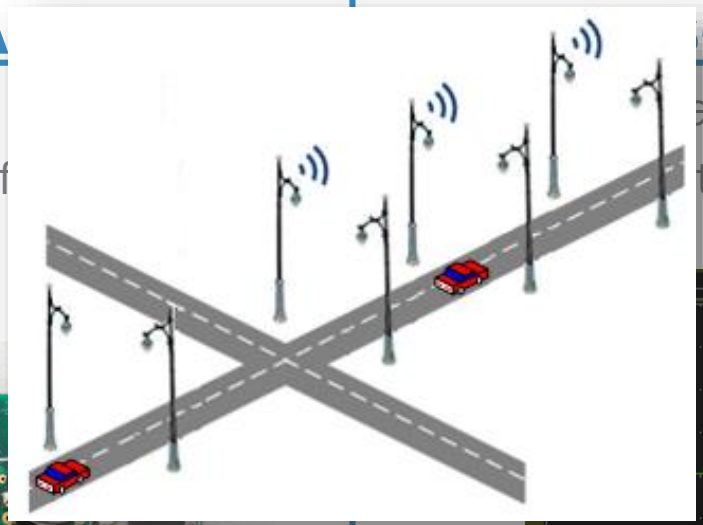
HARDWA

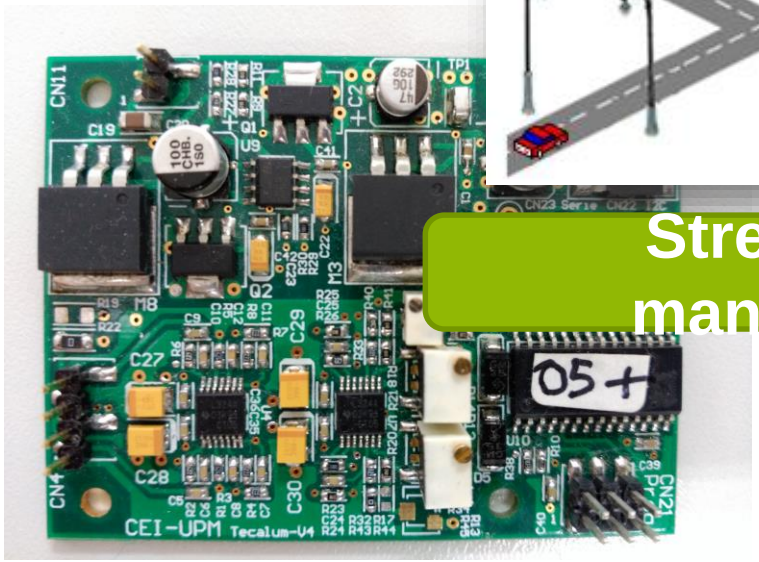
- Radar device
- DSP-based platform f
  radar signal

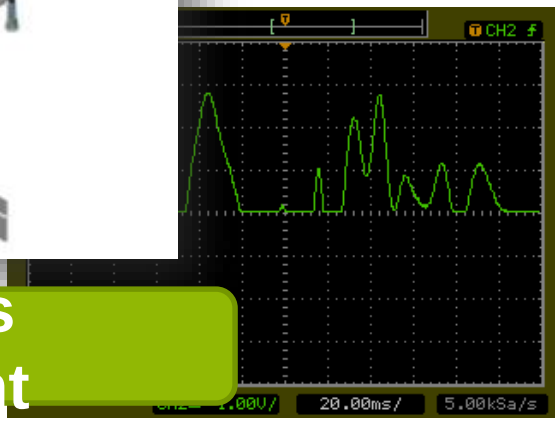
OFTWARE

equency analysis

tem: Classification Tree



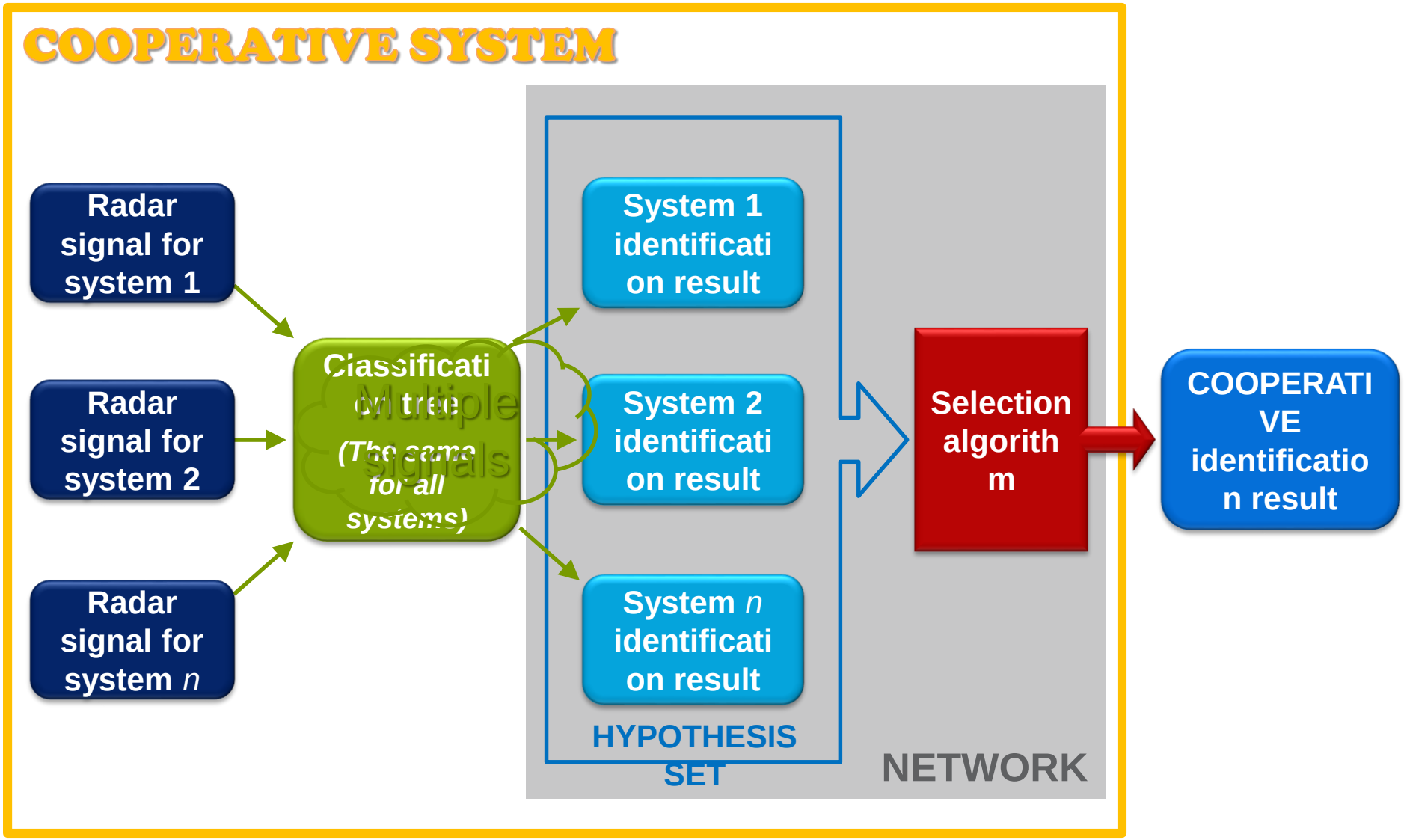




Streetlamps management

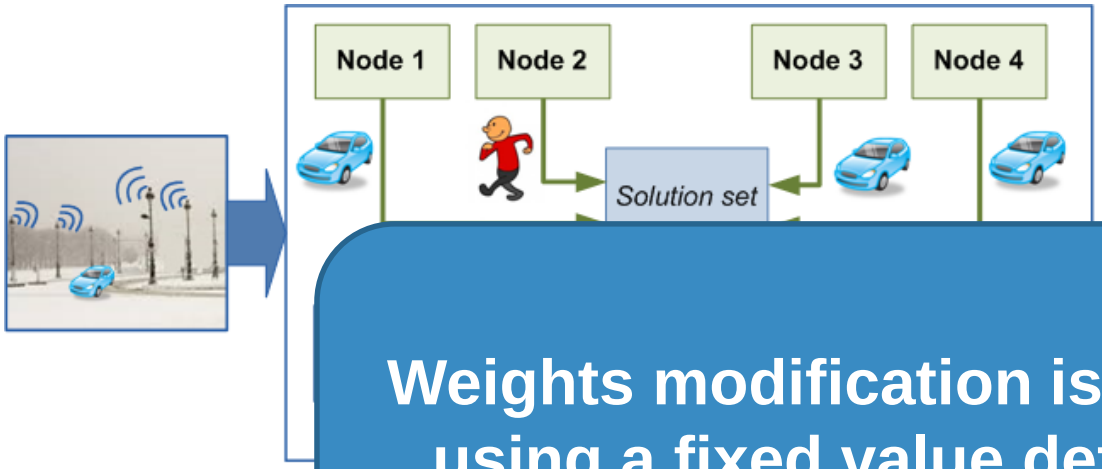
Perez, D.; Villaverde, M.; Moreno, F.; Nogar, N.; Ezcurra, F.; Aznar, E., "Low-Cost Radar-Based Target Identification Prototype using an Expert System," *12th IEEE International Conference on Industrial Informatics (INDIN 2014)*. Porto Alegre (Brazil). July 2014.

Cooperative System



Selection Algorithm: *Previous Solutions*

- **Majority Voting**



Villaverde, M.; Pérez, D.; Moreno, F., "Cooperative Learning Model based on Multi-Agent Architecture for Embedded Intelligent Systems". *IEEE 40th International Conference on Industrial Electronics (IECON)*, pp. 2724-2730, Oct. 29 2014-Nov. 1 2014.

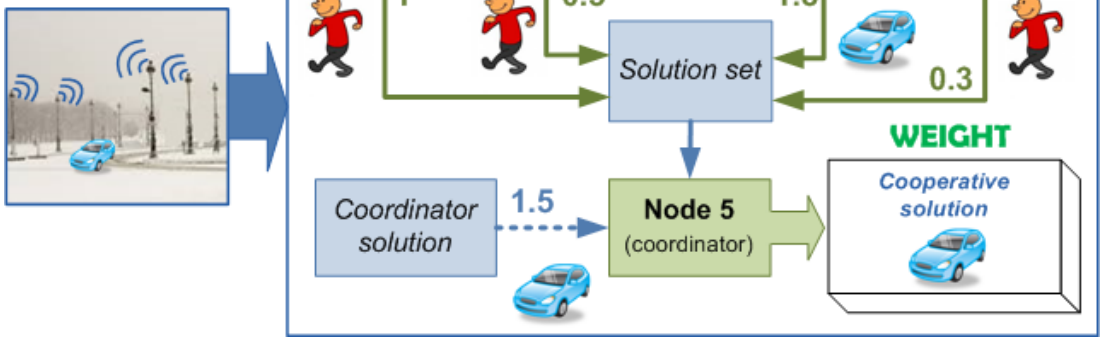
Weights modification is always done using a fixed value defined by the programmer.

...es are not ...e following ...ons.

Weighting a... the impact ... identification and to consider past experiences (learning)

Different reward/penalization procedures were analyzed

...ed Voting



New proposals: Particle Filter

- Particle Filter based Solution

Estimate the future state of a dynamic system

Based on the Montecarlo method

Set of particles. Each one represented by a duo (value & weight).

Particles move towards the converge zone according to the previous weights.

- Particle Filter based Method

Number of subsystems: *n-dimensional space*

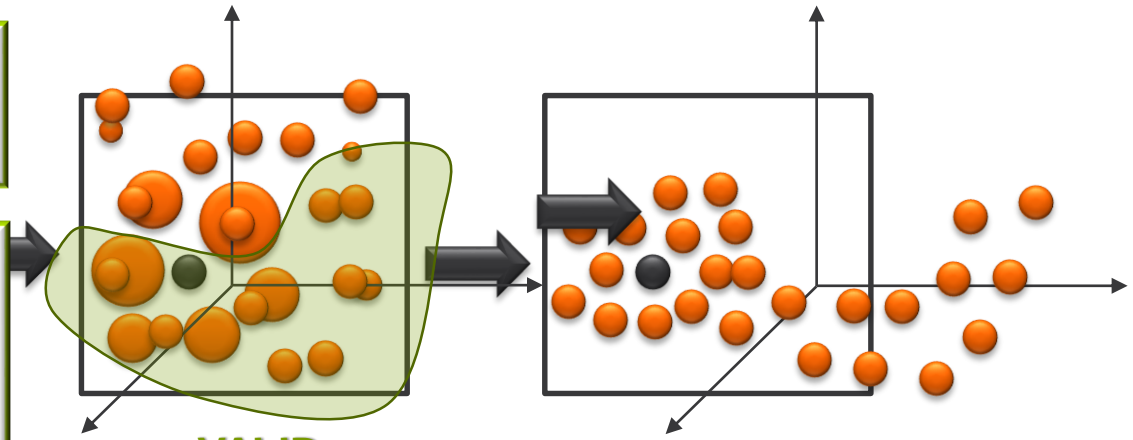
Particle weights are not considerer

Particles are valid or invalid (i.e. according to the cooperative solution)

New particles are placed close to the valid particles.

The axes represent the weights assigned to each subsystem.

Tridimensional space implies 3 subsystems. Each particle is represented by 3 weights.



VALID PARTICLES

New proposals: Particle Filter

- Particle Filter based Solution
  - Standard Particle Filter
  - Particle Filter based Method

Weights (particles) represent past experiences

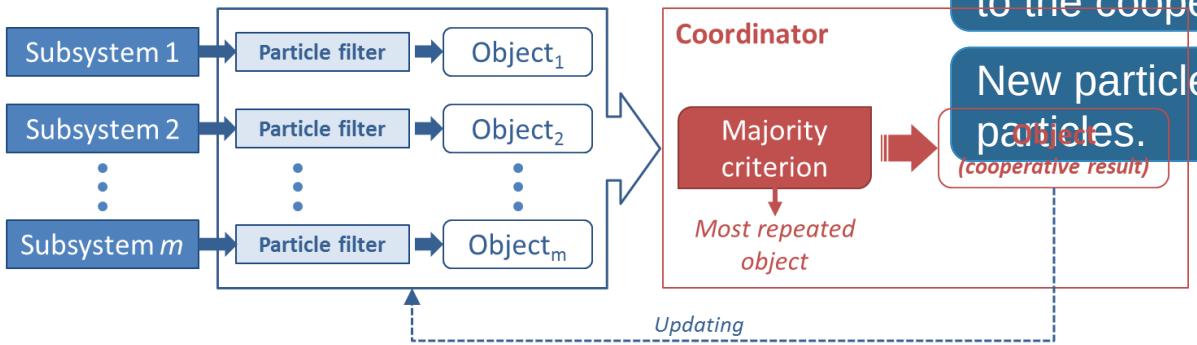
Number of subsystems: *n-dimensional*

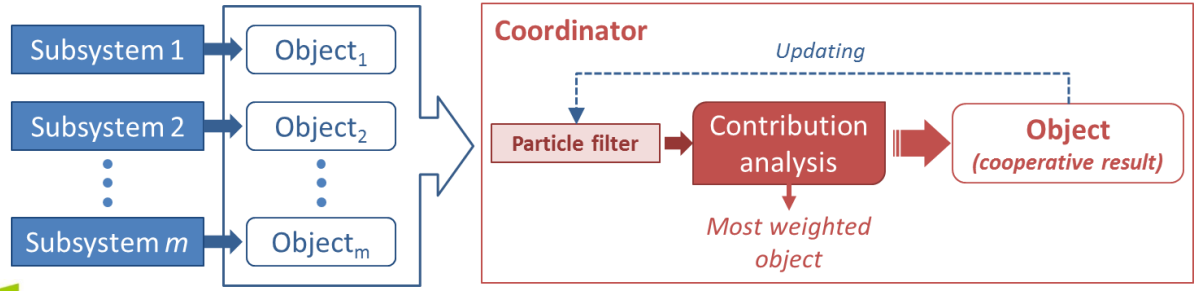
not considerer

Particles are valid or invalid (i.e. according to the cooperative subsystem).

New particles.

Each subsystem has to dealt with its own particle filter.
The final solution is given by the most repeated category.





Just one particle filter. The final solution is given by the most weighted category.

New proposals: Contributions based on probabilities

- Contributions-based Procedure

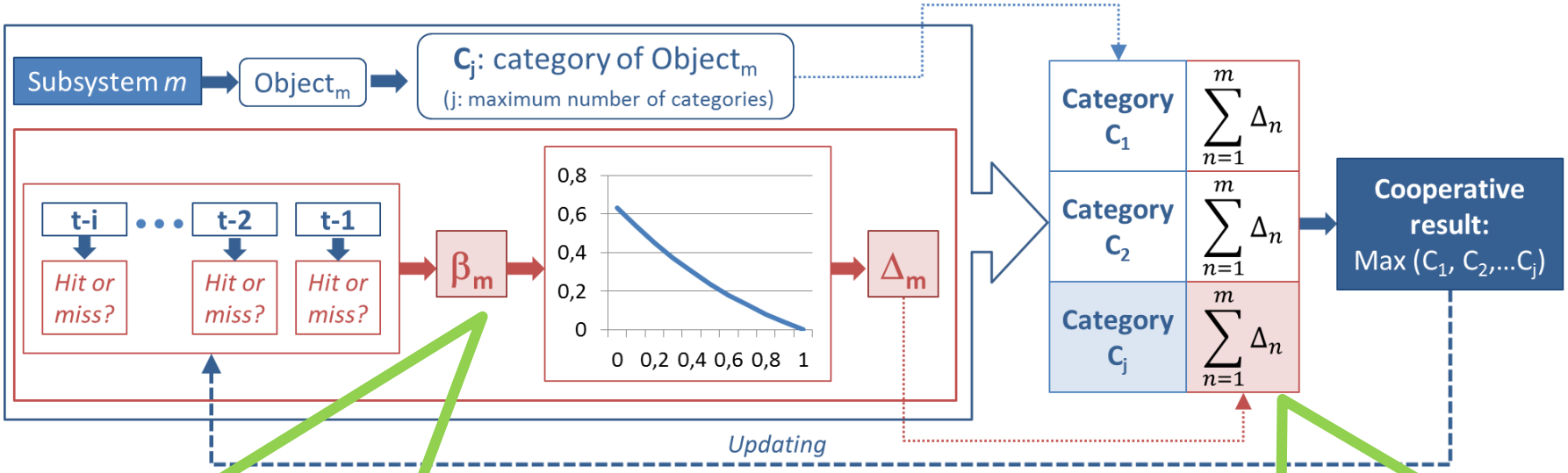
Probability of failure of the last i-evolutions (β_m)

→ β_m : Varies between 0 and 1

Contribution of the subsystem m:

$\Delta = \square - \square$

→ Δ_m : Varies between 0 and 0.6321



β_m is updated depending on whether the solution of the subsystem matches the cooperative solution or not.

The category that has higher contribution is the cooperative solution.

THANK YOU FOR YOUR ATTENTION